WELCOME

The publishers of this Avionics Maintenance Technician Certification Series welcome you to the world of aviation maintenance. As you move towards EASA certification, you are required to gain suitable knowledge and experience in your chosen area. Qualification on basic subjects for each aircraft maintenance license category or subcategory is accomplished in accordance with the following matrix. Where applicable, subjects are indicated by an "X" in the column below the license heading.

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We wish you good luck and success in your studies and in your aviation career!

REVISION LOG

VERSION	EFFECTIVE DATE	DESCRIPTION OF CHANGE
001	2016 01	Module Creation and Release
002	2019 10	Format Update
002.1	2022 06	Clarified number of electrons in orbital shells. Sub-Module 01, page 1.4

MODULE EDITIONS AND UPDATES

ATB EASA Modules are in a constant state of review for quality, regulatory updates, and new technologies. This book's edition is given in the revision log above. Update notices will be available Online at *www.actechbooks.com/revisions.html*
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MEASUREMENT STANDARDS

SI Units
Measurements in this book are presented with International System of Units (SI) standards in all cases except when otherwise specified by ICAO (for example, altitude expressed in feet or performance numbers as specified by a manufacturer). The chart below can be used should your studies call for conversions into imperial numbers.

Number Groups
This book uses the International Civil Aviation Organization (ICAO) standard of writing numbers. This method separates groups of 3 digits with a space, versus the European method by periods and the American method by commas. For example, the number one million is expressed as:

ICAO Standard	1 000 000
European Standard	1.000.000
American Standard	1,000,000

Prefixes
The prefixes in the table below form names of the decimal equivalents in SI units.

MULTIPLICATION FACTOR	PREFIX	SYMBOL
1 000 000 000 000 000 000 = 10^{18}	exa	E
1 000 000 000 000 000 = 10^{15}	peta	P
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^{9}	giga	G
1 000 000 = 10^{6}	mega	M
1 000 = 10^{3}	kilo	k
100 = 10^{2}	hecto	h
10 = 10^{1}	deca	da
0.1 = 10^{-1}	deci	d
0.0 1 = 10^{-2}	centi	c
0.001 = 10^{-3}	milli	m
0.000 001 = 10^{-6}	micro	µ
0.000 000 001 = 10^{-9}	nano	n
0.000 000 000 001 = 10^{-12}	pico	p
0.000 000 000 000 001 = 10^{-15}	femto	f
0.000 000 000 000 000 001 = 10^{-18}	atto	a

COMMON CONVERSIONS

IMPERIAL SYSTEM	TO	SI (METRIC)
Distance		
1 Inch	is equal to	2.54 Centimeters
1 Foot	is equal to	0.304 Meters
1 (Statute) Mile	is equal to	1.609 Kilometers
Weight		
1 Pound	is equal to	0.454 Kilograms
Volume		
1 Quart	is equal to	0.946 Liters
1 Gallon	is equal to	3.785 Liters
Temperature		
˚0 Fahrenheit	is equal to	(-)17.778 Celsius (˚C)
˚0 Fahrenheit	is equal to	255.37 Kelvin (K)
Area		
1 Square Inch	is equal to	6.451 Square Centimeters
1 Square Foot	is equal to	0.093 Square Meters
1 Square Mile	is equal to	2.59 Square Kilometers
Velocity		
1 Foot Per Second	is equal to	0.304 Meters Per Second
1 Square Inch	is equal to	1.609 Kilometers Per Hour
1 Square Inch	is equal to	1.852 Kilometers Per Hour

SI (METRIC)	TO	IMPERIAL SYSTEM
Distance		
1 Centimeter	is equal to	0.394 Inches
1 Meter	is equal to	3.28 Feet
1 Kilometer	is equal to	0.621 Miles
Weight		
1 Kilogram	is equal to	2.204 Pounds
Volume		
1 Liter	is equal to	1.057 Quarts
1 Liter	is equal to	0.264 Gallons
Temperature		
˚0 Celsius (˚C)	is equal to	33.8˚ Fahrenheit
˚0 Kelvin (K)	is equal to	(-)437.87 Fahrenheit
Area		
1 Square Centimeter	is equal to	0.155 Square Inches
1 Square Meter	is equal to	10.764 Square Feet
1 Square Kilometer	is equal to	0.386 Square Miles
Velocity		
1 Meter Per Second	is equal to	3.281 Feet Per Second
1 Kilometer Per Hour	is equal to	0.621 Miles Per Hour
1 Kilometer Per Hour	is equal to	0.540 Knots

Pressure		
pounds per square inch (psi)	kiloPascals (kPa)	6.988
pounds per square inch (psi)	Pascals (Pa)	6.895

a useful temperature range make it ideal for use among many applications. Germanium was widely used early on; however, its thermal sensitivity makes it less useful than silicon. Germanium is often combined with silicon to make very high-speed Silicon-Germanium (SiGe) devices. In addition, Silicon is often combined with Carbon to form Silicon-Carbide (SiC) devices for high-power and high-temperature applications.

Compound semiconductors do not appear in nature, but are synthesized using two or more elements from groups II through VI of the periodic table. Compound semiconductors that can be synthesized using elements from 3rd and 5th group of the periodic table include Gallium-Arsenide (GaAs), Gallium-Phosphide (GaP), Gallium-Nitride (GaN), Gallium-Aluminum-Arsenide (GaA1As), Indium-Phosphorus (InP), and Indium-Antimony (InSb). The color of light that emits from a Light Emitting Diode depends on which of these compounds are used.

Compound semiconductors that are synthesized using elements from 2nd and 6th group include Cadmium-Selenium (CdSe), Cadmium-Tellurium (CdTe), Cadmium-Mercury-Tellurium (CdHgTe), and Zinc-Sulfer (ZnS). Light detectors, such as photocells, are typically made from InSb or CdSe compounds. Any combination of elements, such as zinc, cadmium, boron, aluminum, gallium, indium, carbon, silicon, germanium, tin, phosphorous, arsenic, antimony, sulfur, selenium, and tellurium, can be formed in to compound semiconductors with various properties.

ELECTRON BEHAVIOR IN VALENCE SHELLS

An atom of any material has a characteristic number of electrons orbiting the nucleus of the atom. The arrangement of the electrons occurs in somewhat orderly orbits called rings or shells. In most cases, the closest shell to the nucleus can only contain two electrons. If the atom has more than two electrons, those are found in the next orbital shell away from the nucleus. The second shell can only hold eight electrons. If the atom has more than 10 electrons (2 + 8), they orbit a third shell further out from the nucleus which can hold a maximum of 18 electrons. If the atom has more than 28 electrons (2 + 8 + 18) a fourth shell forms which can hold up to 32 electrons, etc. ***(Figure 1-3)***

Shell or Orbit Number	1	2	3	4	5
Maximum Number of Electrons	2	8	18	32	50

Figure 1-3. Maximum number of electrons in each orbital shell of an atom.

The outer most orbital shell of any atom's electrons is called the valence shell. The number of electrons in the valence shell determines the chemical properties of the material. When the valence shell has the maximum number of electrons, it is complete and the electrons tend to be bound strongly to the nucleus. Materials with this characteristic are chemically stable. It takes a large amount of force to move the electrons in this situation from one atom valence shell to that of another. Since the movement of electrons is called electric current, substances with complete valence shells are known as good insulators because they resist the flow of electrons (i.e., electricity). Most insulators are compounds of two or more elements that share electrons to fill their valence shells. ***(Figure 1-4)***

In atoms with an incomplete valence shell, that is, those without the maximum number of electrons in their valence shell, the electrons are bound less strongly to the nucleus. The material is chemically disposed to combine with other materials or other identical atoms to fill in the unstable valence configuration and bring the number of electrons in the valence shell to maximum. Two or more substances may share the electrons in their valence shells and form a covalent bond. A covalent bond is the method by which atoms complete their valence shells by sharing valence electrons with other atoms.

Electrons in incomplete valence shells may also move freely from valence shell to valence shell of different atoms or compounds. In this case, these are known as free electrons. As stated, the movement of electrons

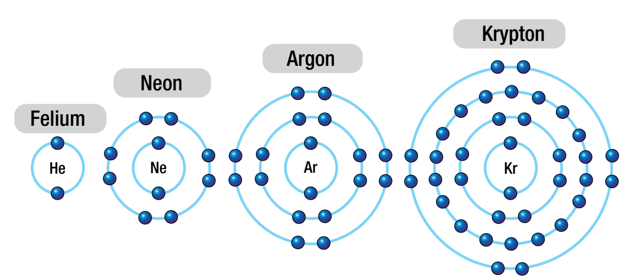

Figure 1-4. Elements with full valence shells are good insulators.